Emissions from Oriented Strand Boards (OSB) Covered with Gypsum Plates

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INTRODUCTION

Good insulation of new buildings has become legal requirement under the Energy Performance of Buildings Directive (2002/91 EC) in Europe. The choice of low emitting building material, especially in family homes where we spend a lot of time per day, has become more relevant for a good indoor air quality. Raising the ventilation rate is another method to improve indoor air quality but it contradicts energy saving. Ventilation alone therefore cannot solve the problem of high emitting materials sustainably.

An increasing part of new family house constructions in Germany use wood based panels for wall constructions, especially oriented strand boards (OSB) from pine wood (Pinus sylvestris). Emissions from these materials like terpenes and aldehydes are well known. Parts of wood industry suppose these emissions to be very low under practical conditions inside the building since OSB would normally be covered by other inner wall materials which minimize the emissions of volatile organic compounds (VOC) into indoor air.

METHODS

UBA investigated the emission pattern of raw OSB-panels compared with the sandwich application of OSB covered with gypsum board. Additionally, a typical piece of wall construction that is used in low energy houses has been set up and investigated under more realistic conditions. The following investigations have been done:

(A) From eight commercially available OSB-panels (age: about 6 months after manufacturing, stored in batch) two samples were cut with the size 45 cm by 45 cm. One was covered by a gypsum plate. Except the upper surface (the one covered with gypsum plate) all other surfaces were sealed by alumina foil and alumina tape. The emissions were measured with a FLEC (Field and Laboratory Emission Cell, Chematec) at q = 1 m^3/m^2h and 50% r.h.. Emissions were determined after 3, 28 and 70 days. This procedure was repeated and performed 8 times. Between the single measurements the covered and uncovered samples were stored separately, to avoid cross contamination, in two 1 m^3 chambers with an air exchange rate of 1 /h and 50% r.h.

(B) An inner wall model was constructed with two more panels of OSB from the same batch. A frame of metal profiles with the size of 50 cm by 100 cm was filled with mineral wool and covered by OSB on both sides. Additionally, both sides were covered with gypsum plates (12.5 mm). The small surfaces were sealed by alumina foil and alumina tape. The emissions of this inner wall model with an emitting surface of 1 m^2 were measured in a 1 m^3 stainless steel chamber at an air exchange rate of 0.5 /h and 50% r.h. up to 90 days after construction.

Air samples were taken with Tenax TA tubes. VOC were desorbed by thermal desorption and were analysed by GC-MS and GC-FID. Aldehydes were analysed separately using DNPH samplers (Waters Instr.) and analysed by HPLC (all according to ISO standards 16 000

series). The concentrations of TVOC were obtained by calculating the whole FID area in the range from n-hexane to n-hexadecane as toluene equivalents.
VOC emissions are measured after 1, 2, 3, 7, 10, 24 and 28 days, as well as at day 60 and 90 for long term emissions. The more realistic exposure scenario can be modelled by an area specific airflow of q = 0.5 which should represent the situation of walls as emission source in a standard room (as proposed in the draft harmonised standard of CEN TC 351 WG2).

RESULTS

(A) Comparison between raw OSB emissions and gypsum covered OSB

The results show that gypsum plates do not reduce VOC emissions originated by the OSB. The typical emissions passed the covering gypsum within hours and showed clearly the normal decay in the early days of emission tests. Surprisingly, the emissions of total VOC are not reduced by the covering gypsum board; in fact they are enhanced (see Fig. 1).

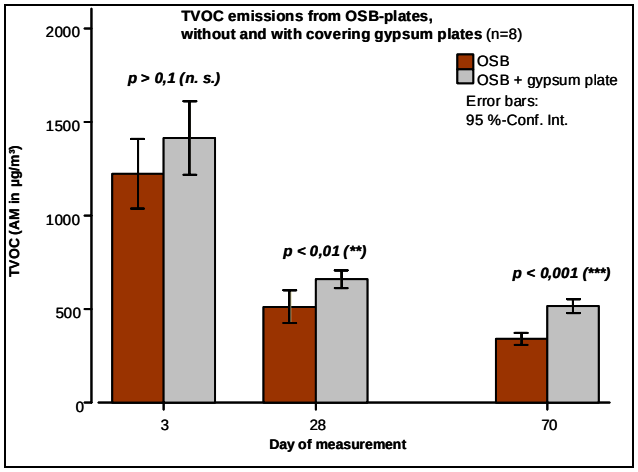

Fig.1 TVOC emissions from OSB-plates, without and with covering gypsum plates, (n=8)

Terpenes show a constant decay within the tested 70 days. However, the covered OSB show significantly higher amounts of all terpenes compared to the emissions of raw OSB.
Aldehydes: Saturated and unsaturated aldehydes show a different behaviour. Hexanal emission pattern is enhanced by gypsum plate covering while unsaturated aldehydes, e.g. heptenal, is retained by the gypsum plate and shows low but constant emissions (Fig.2 a/b)

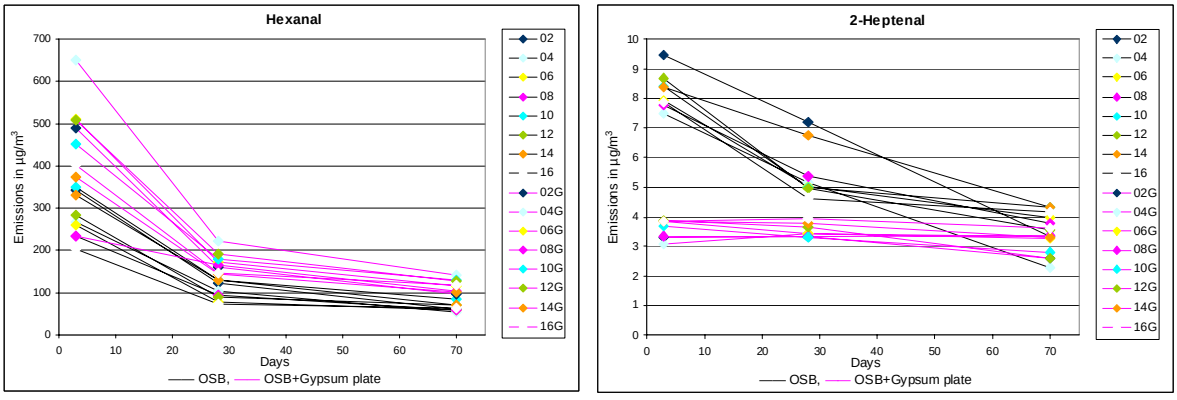

Fig. 2a and 2b.: Examples for different behaviour of aldehyde emissions: a) Hexanal and b) 2-Heptenal

Acetone emissions from OSB are quite relevant. This is consistent with the results from a parallel research project at BAM (Wiegner 2008). However, the quantification remains difficult.

Carbonic acids: In the emissions of uncovered OSB carbonic acids, especially hexanoic acid, were found, but the analytical reproducibility was too bad to give numerical results. However, hexanoic acid could not be found or sometimes was only found with much lower concentrations in the emissions of OSB covered with gypsum board as well as in part B. Obviously, carbonic acids belong to the group of substances that were retained by the gypsum board.

(B) Emissions of inner wall model

The results show the same emission pattern as OSB + gypsum plate in **(A).** Details for the group of saturated aldehydes and ketones (exept acetone) are given in Fig 3. The major aldehyde peaks emitted by OSB were acetaldehyde, pentanal and hexanal, this pattern was not altered by the covering gypsum plate but the amount was higher as shown in part A. Formaldehyde, which may be relevant for other wood based panels, showed only low emission concentrations. It seems that formaldehyde emissions are not relevant for OSB made from pine wood.

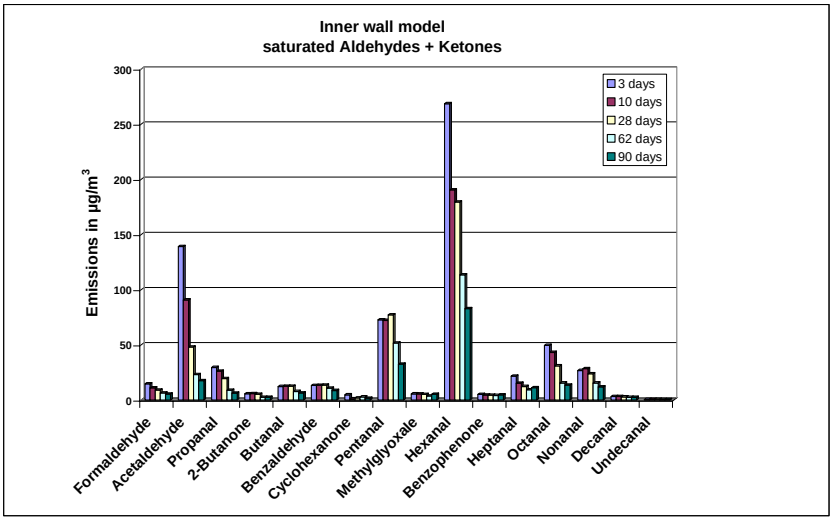

Fig. 3: Inner wall model: Details for saturated aldehydes and ketones

DISCUSSION

In Germany, emission performance tests have become a legal requirement for a growing part of relevant indoor building materials, such as all kinds of flooring materials (Däumling 2004, DIBt 2004, 2007). Oriented strand boards as (inner) wall material is not subject of emission requirements yet but their emissions can be detected in relevant amounts in indoor environments of new houses if used in wall construction (Thalmann 2008). Some parts of wood panel industry in Europe argue that the impact of VOC from OSB on indoor air can only be very low as the OSB are not exposed directly to indoor air but covered with other inner wall material. Nevertheless, a lot of research activities are presented by the wood industry itself and by related research institutes. (Makowski 2005, Ohlmeyer 2008). Our investigations show that gypsum plates do not prevent or minimize VOC emissions from OSB if these are used as construction elements. The reason for the surprising increase of emissions in the reported sandwich application is object of further investigations.

For health evaluation the emission of irritants are of major concern. Considering all irritants generated by OSB in the test chamber after 90 days, the total amount of irritants - including the very volatile substances as acetaldehyde and acetone - can even be higher as the TVOC (here 480 µg/m³ irritants compared to 450 µg/m³ TVOC, Fig 4). If this material-related indoor concentration of irritants is still increased in real life by raised temperature in summer times

and by ozone (from outdoor air) with its reaction products (especially terpene reaction products) (ECA 26, 2007), the indoor air quality conditions can deteriorate significantly. High indoor concentrations and complaints by inhabitants are possible (Schünemann 2004)

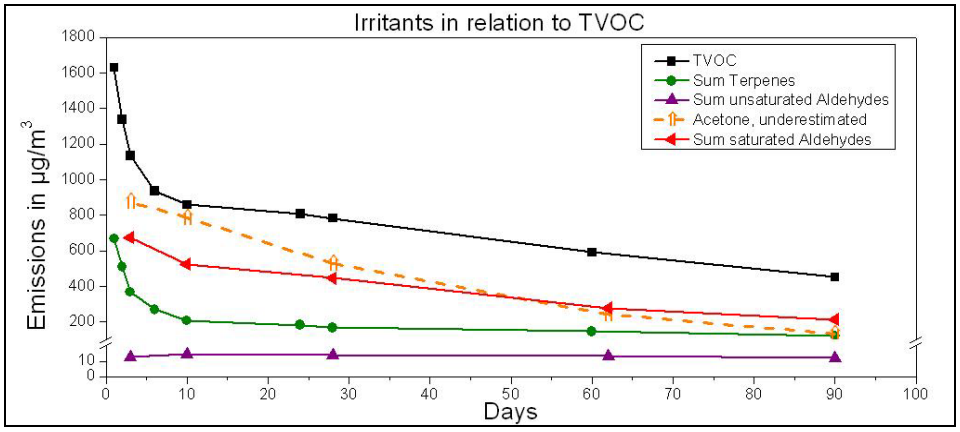

Fig.4 Amount of irritants (sums of terpenes, aldehydes and acetone) compared to TVOC.

The need of developing low emitting OSB is even more important, if this material is to be used for large areas in the building construction. One possibility to reduce emissions from OSB may be to store the boards for a longer time before use. However, a remedy by storage would affect the costs of production for the industry. Anyway, building system designers, engineers and architects should be aware and reflect the amount of emitting sources in the choice of construction material.

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